NORTH CAROLINA
Department of Transportation

Early Pavement Distress Investigations

Materials and Tests Unit

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Problem Statement

In recent years more and more projects are being identified which experience slippage distress early on in their pavement life.

Why Now?

A common question that is asked is: “Why is this happening now? This didn’t happen in the past!”

Have the mixtures changed?

Have the source materials changed?

Has the traffic changed?

Has the climate changed?

Have construction practices changed?

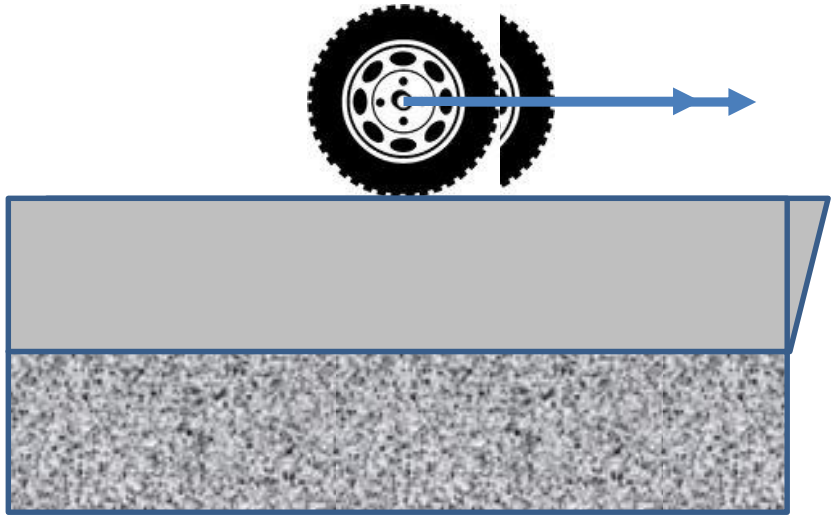
Have production practices changed?

Answer: Yes

(but that doesn’t mean they are all related to the problem)

Understanding Slippage Failure (Simplified Schematic)

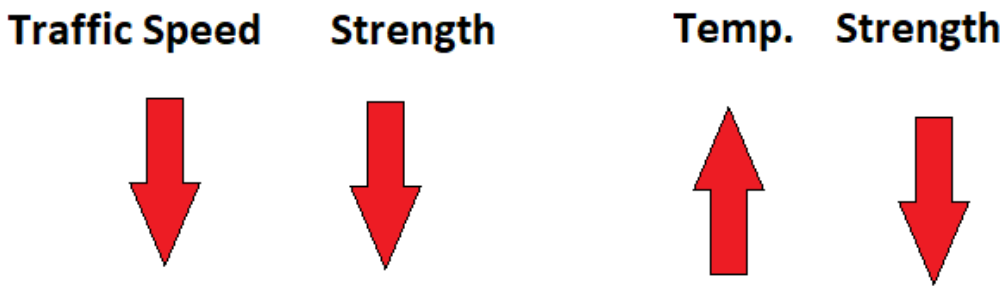
Good Bond



Reality is more complex

- Pavement layers are long, wide, and thin, not short bricks (which means: the stress distribution is complex)
- Things to keep in mind:
  - Stresses tend to dissipate deeper in the pavement
  - Temperature and traffic speed affect the stress distribution as well as the strength

Deeper in Pavement => Lower Stress (Generally)



Ongoing and Future Investigations

- Division Investigations: Division 6 has produced a list of projects with and without early slippage distress within the division
  - Mixes experiencing slipping
  - Areas where slipping is occurring (entire route or certain locations, etc.)
  - Treatment performed in the areas of slipping (overlay or new location, milling or no milling, etc.)
  - M&T is working to add additional information to this project list (QC/QA test results, pavement condition, project information, truck traffic, etc.)
  - M&T is working to expand this project list with information from other divisions

- Supplementary testing with Trimat Testing:
  - Focused on testing several “real world” mixes
  - The goal is to confirm/rule out important factors identified by the previous investigations
  - Tests to be performed:
    - IDEAL CT cracking test
    - Semi-Circular Bend cracking test
    - Hamburg Rutting test
    - APA Rutting test

- Research project with NC State (Dr. Cassie Castorena):
  - Focused on understanding the blending between the virgin and recycled binder in the mixture, and its effects on the mix and the mix design procedure.

Factors Under Investigation

Important points to remember:

- There are likely multiple factors going on at one time. No “Smoking gun”.
- Correlation **DOES NOT** necessarily mean causation.
- The dataset is currently limited and apparent correlations may not hold up once more data is collected from other Divisions and laboratory tests.
- Two types of factors are being investigated: mix factors and project factors

Potential Project factors under investigation
Locations with high shear stresses (Intersections, ramps, sharp curves, etc.)
Pavement Treatment type
Existing pavement condition prior to paving

Potential Mix factors under investigation
Higher VFA
Finer gradation
Higher natural sand content
Higher pecentage of Shingles & RAP (higher reycled binder content)

What Factors increase risk of slippage failure?

- Decrease in interfacial bond strength
  - Smooth surface (e.g.: Polished aggregate on existing surface)
  - Inadequate tack coat rate
    - Absorption into the existing pavement
    - Improper placement
  - Dirty surface (e.g. mud from adjacent housing development or farm field)
  - Slow traffic speeds and/or higher temperatures
  - Moisture in the pavement structure (especially at the interface)

- Increase in applied loads
  - More truck traffic (more applied loads)
  - Exceptionally heavy vehicles (e.g.: abnormal number of oversized loads)
  - Areas of acceleration, deceleration, or sharp curves

How to reduce the risk of slippage failures?

While research is continuing, ways to manage risk of slippage failures include:

1) Pay attention to high risk areas

   -Ramps, sharp curves, & intersections

   -Roads with high, heavy, or slow truck traffic

   -Areas with a history of moisture in the pavement structure & poor drainage

2) Consider bond strength between layers during treatment selection

   -Milling can be used to increase interfacial bond strength by:

   - Increasing mechanical bond (surface roughness)
   - Removing existing cracked and oxidized pavement which may ravel or absorb more tack coat than expected

   -Keep in mind: adding pavement thickness **IS NOT** beneficial if bond strength is sacrificed to do so

3) If weak existing layers (cracked or stripped) must remain in place

   -Ensure they are lower in the final structure

   -Due to construction phasing, be aware that weak layers may still be near the surface, and thus prone to failure before the final layers are placed

4) Pay attention to tack coat

   -Application rate, uniformity, material not mistreated

   -Limit tracking

   -Let M&T know if you have concerns or questions about tack coat quality

   -Due to recent emphasis, we believe the divisions are already doing a better job of this!

What input we need:

- If your division has had a pattern of these types of distresses on multiple projects, M&T would like to talk to you about it.